

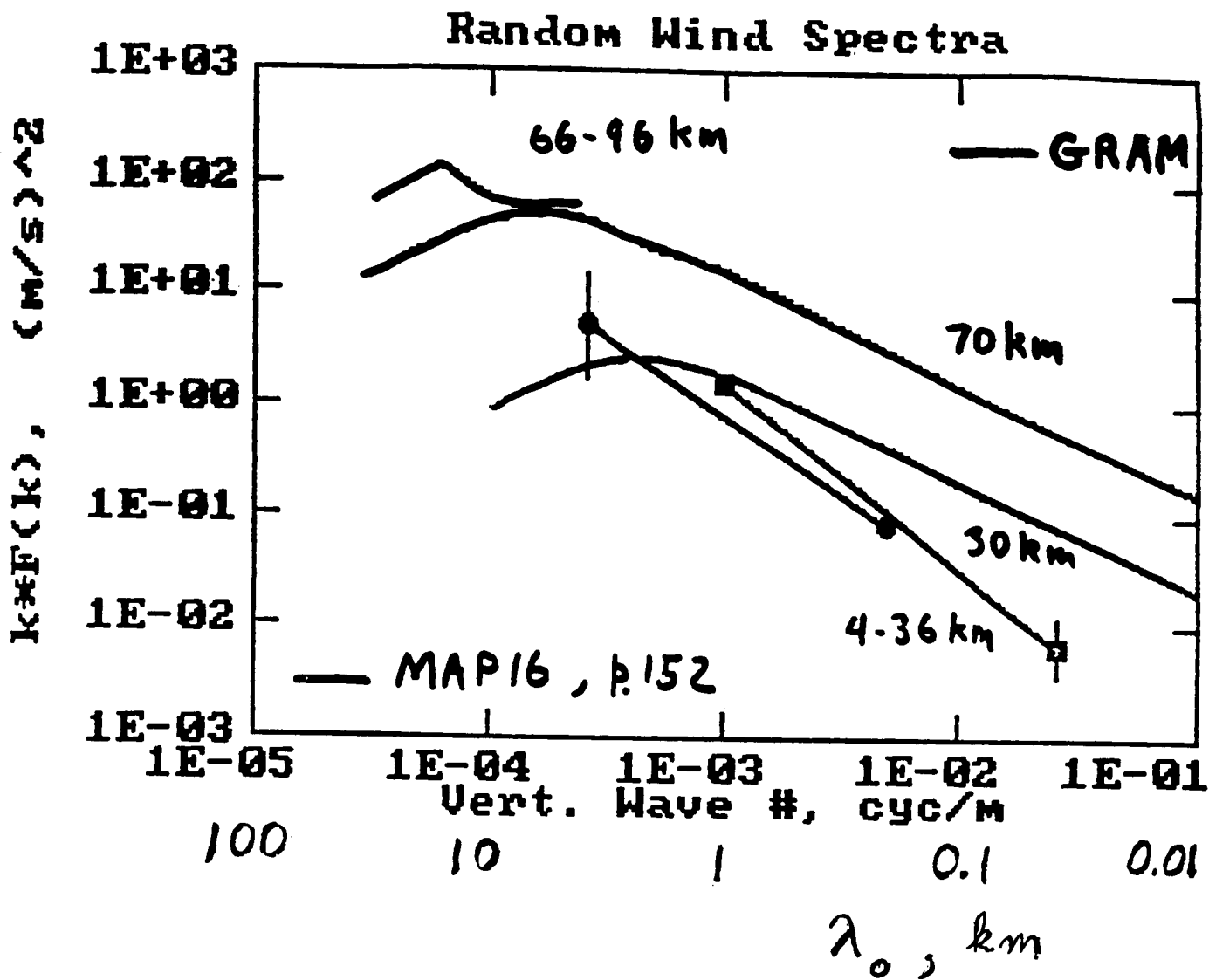
THE GRAM-III MODEL

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The GRAM is under continuous development and improvement. GRAM data were compared with Middle Atmosphere Program (MAP) predictions and with shuttle data (Blanchard).

An important note: Users should employ only step sizes in altitude that give vertical density gradients consistent with shuttle-derived density data. Using too small a vertical step size (finer than 1 km) will result in what appears to be unreasonably high values of density shears but what in reality is noise in the model.

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$$\rho(z + \Delta z) = r_\rho(\Delta z) \rho(z) + \beta \sigma_\rho w_z$$

$$\beta = \sqrt{1 - r_\rho^2(\Delta z)}$$

$$r_\rho(\Delta z) = e^{-\Delta z/L}$$

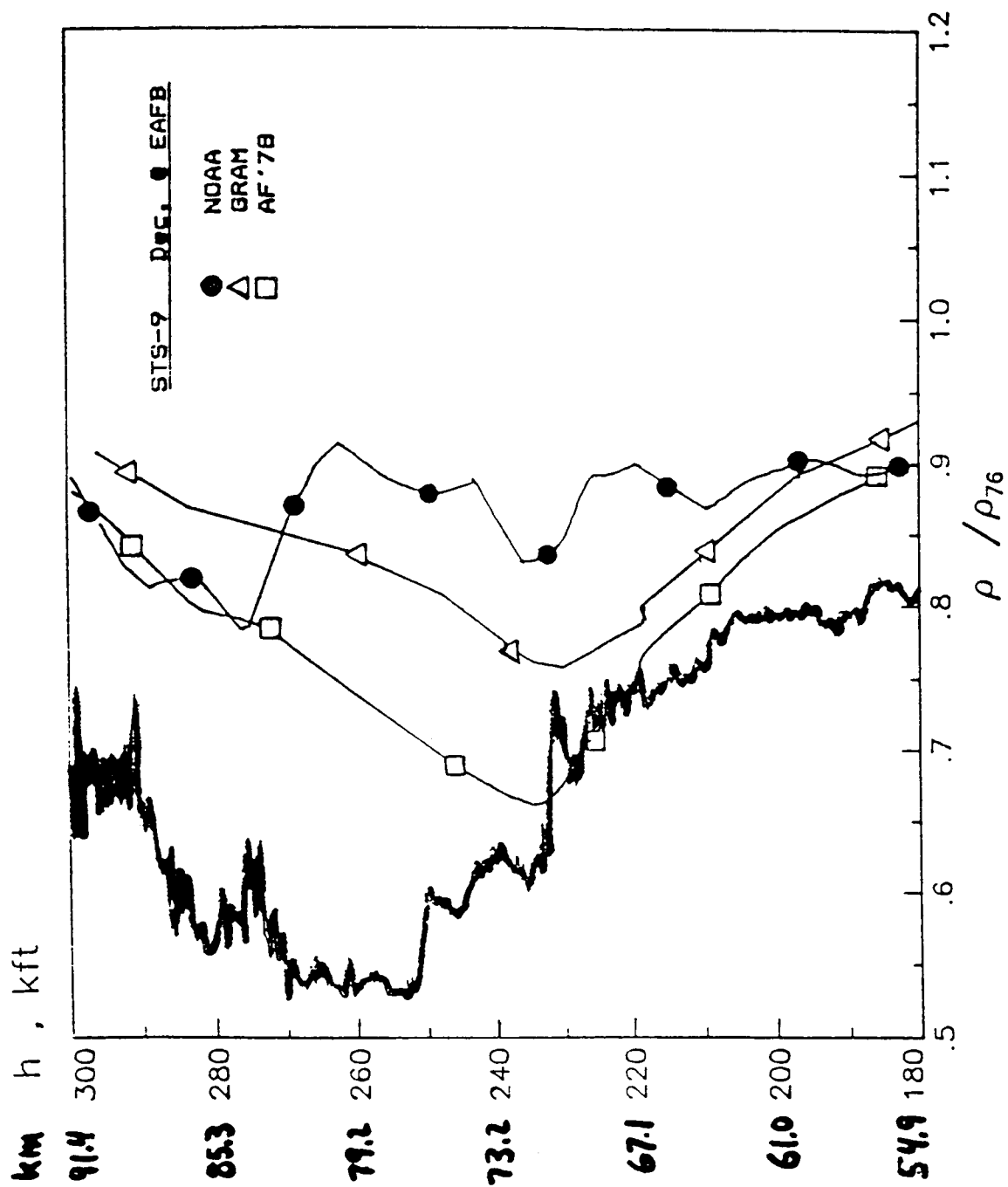
$$\Delta \rho = \rho(z + \Delta z) - \rho(z)$$

$$\overline{(\Delta \rho)^2} \rightarrow 2 \sigma_\rho^2 \Delta z / L \quad \left. \vphantom{\overline{(\Delta \rho)^2}} \right\} \Delta z / L \rightarrow 0$$

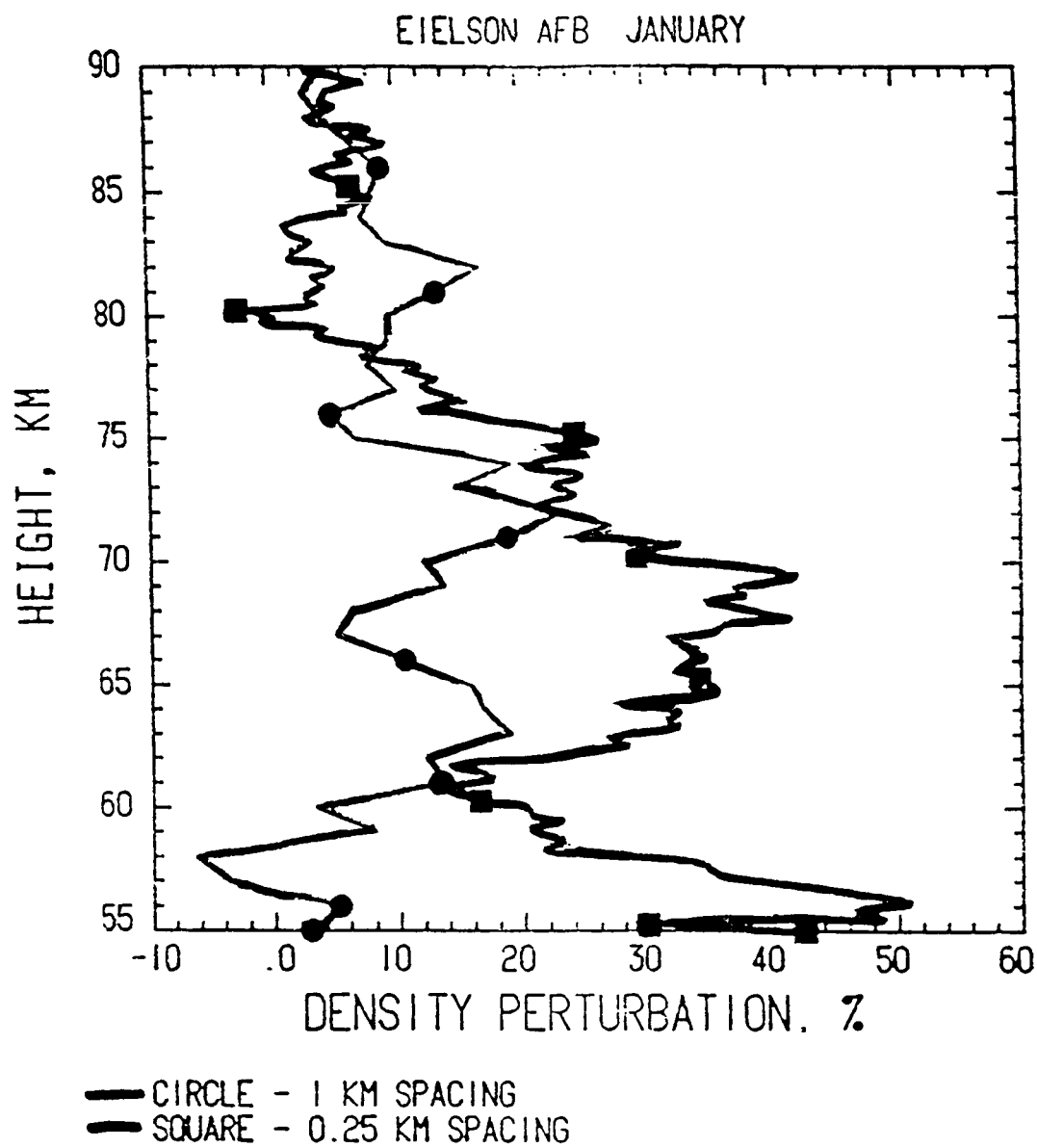
$$\overline{(\Delta \rho / \Delta z)^2} \rightarrow 2 \sigma_\rho^2 / \Delta z L \quad \left. \vphantom{\overline{(\Delta \rho / \Delta z)^2}} \right\}$$

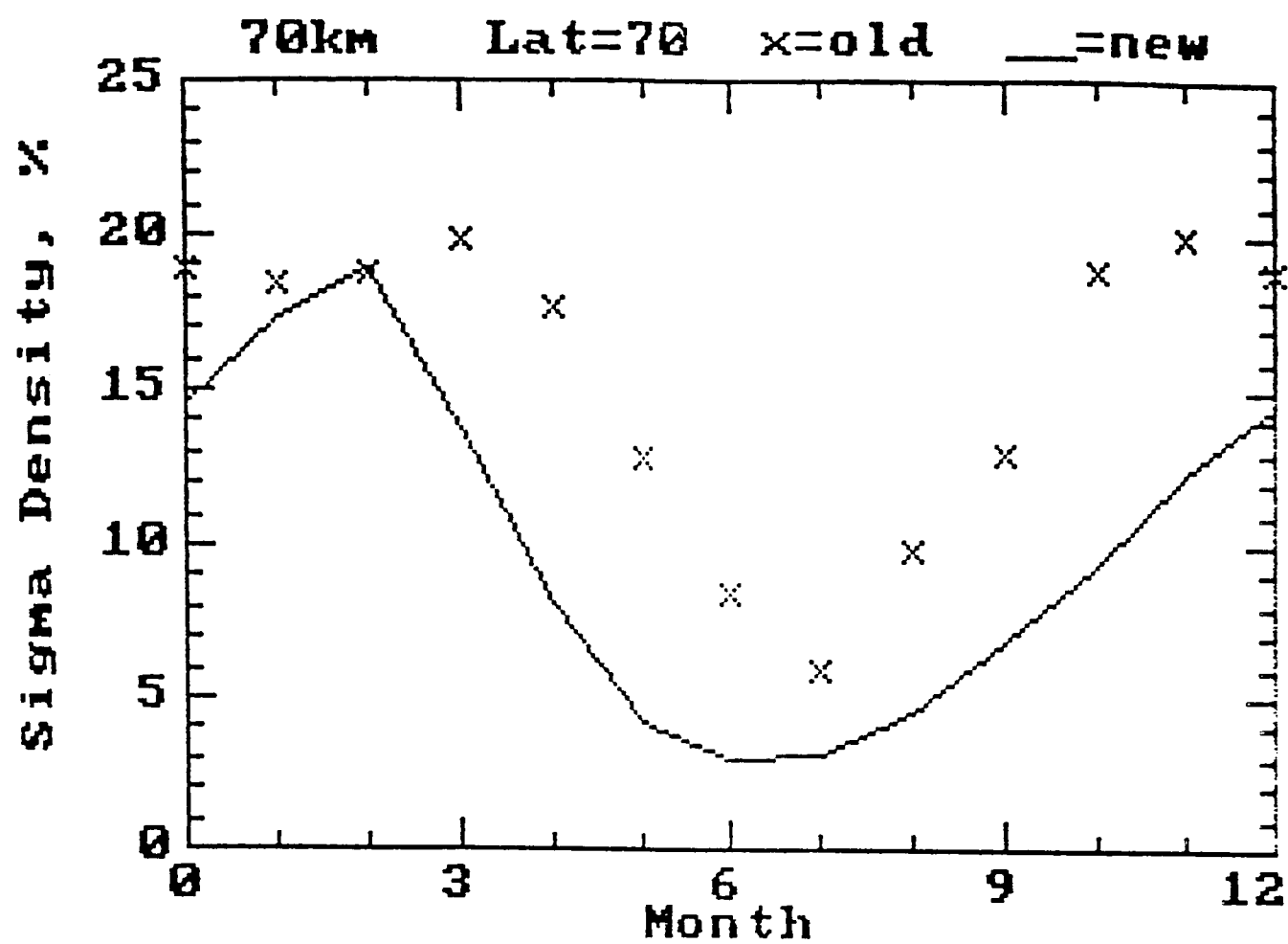
$$E_\rho(k) \sim k^{-2}$$

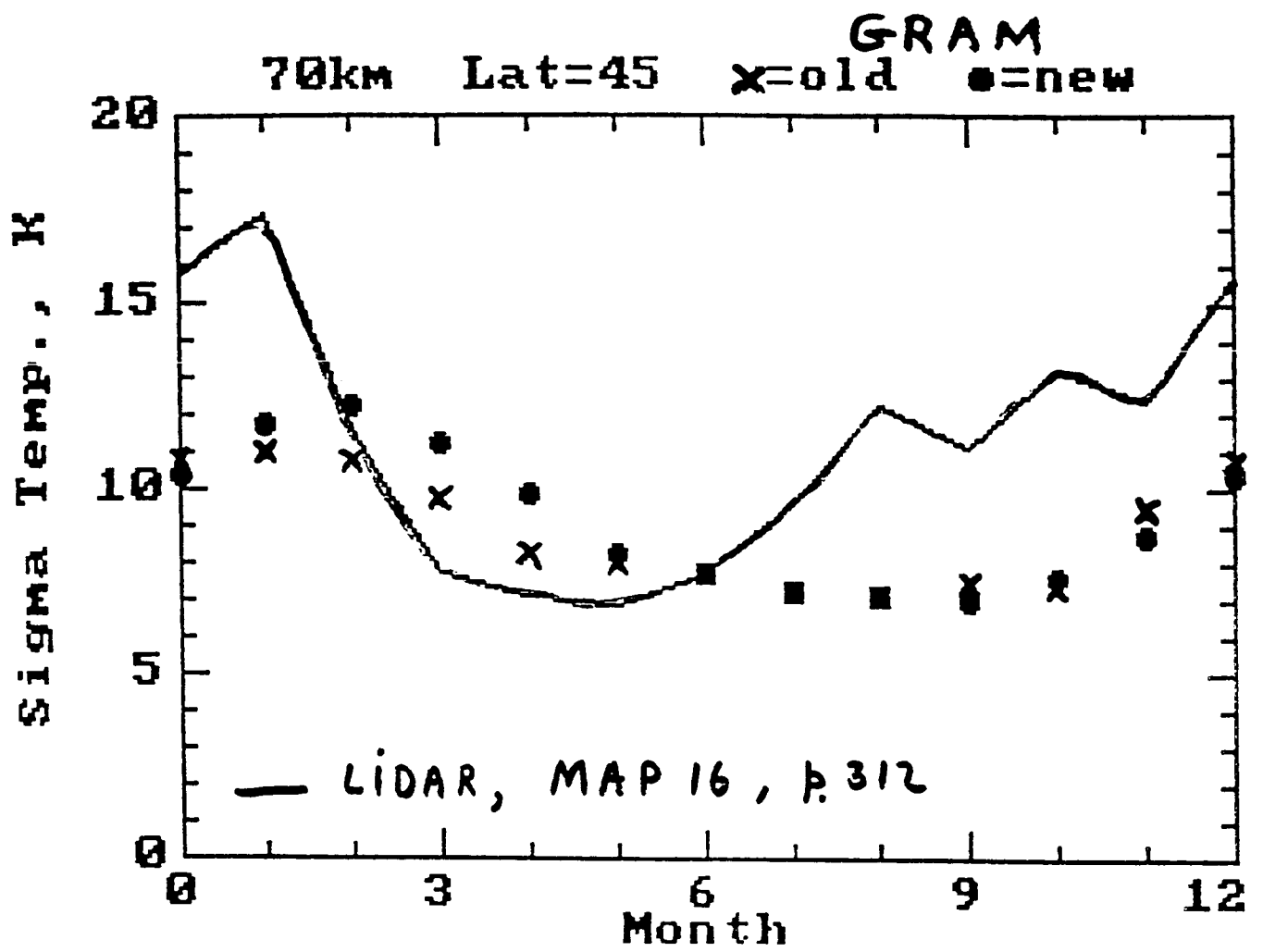
$$kL \rightarrow \infty$$

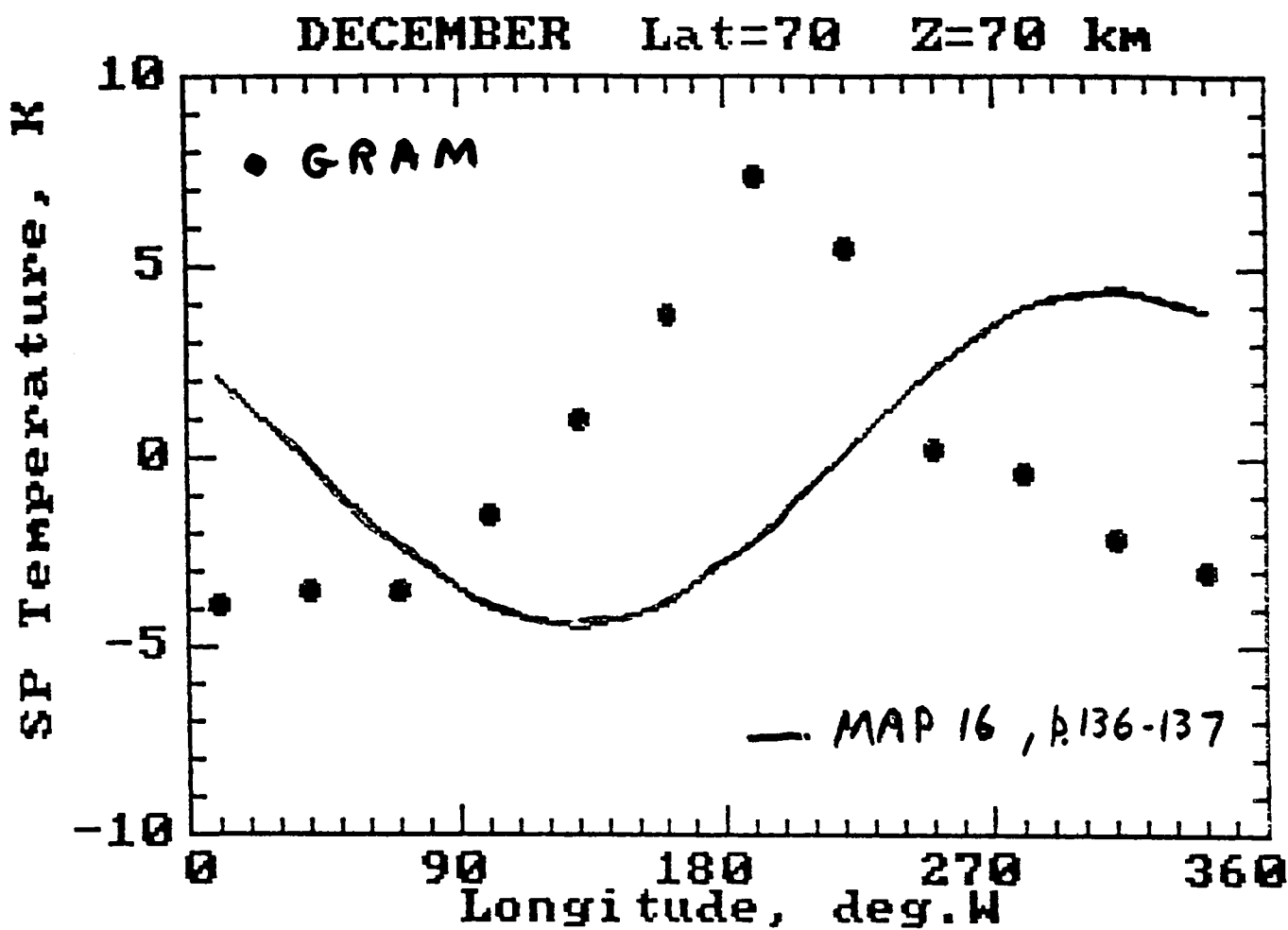


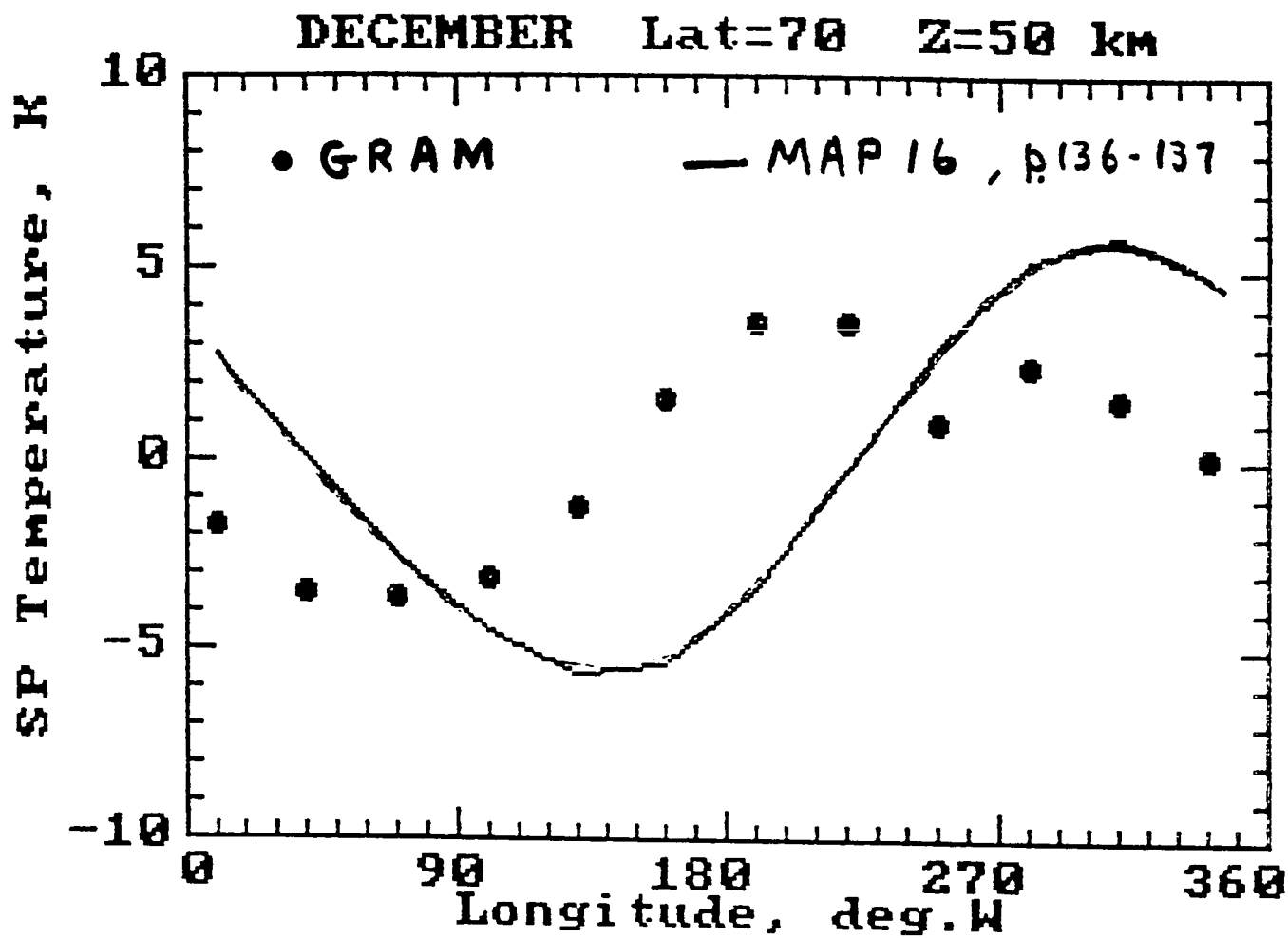
COMPARISONS BETWEEN SHUTTLE DERIVED AND ALTERNATE SOURCES



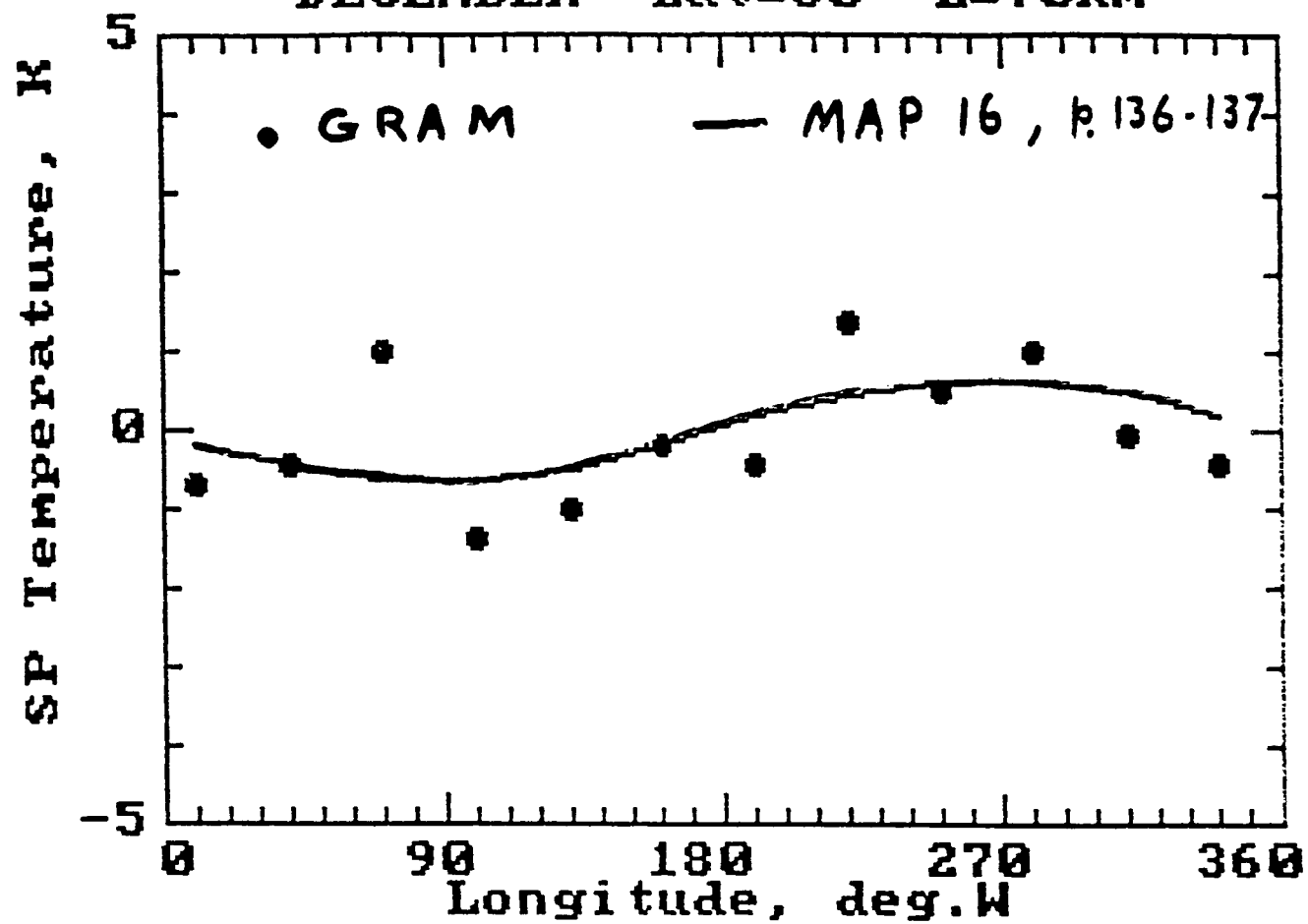


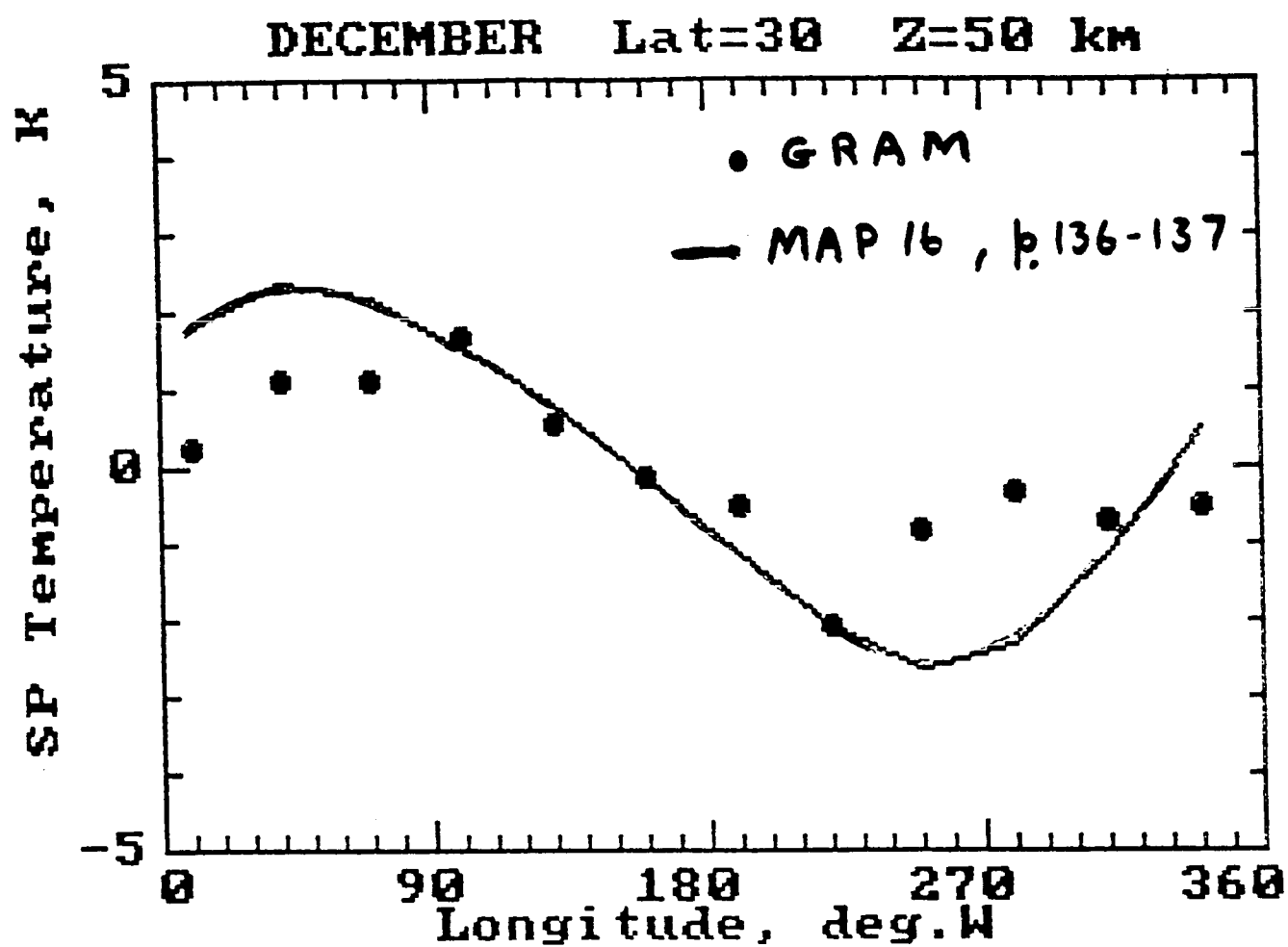


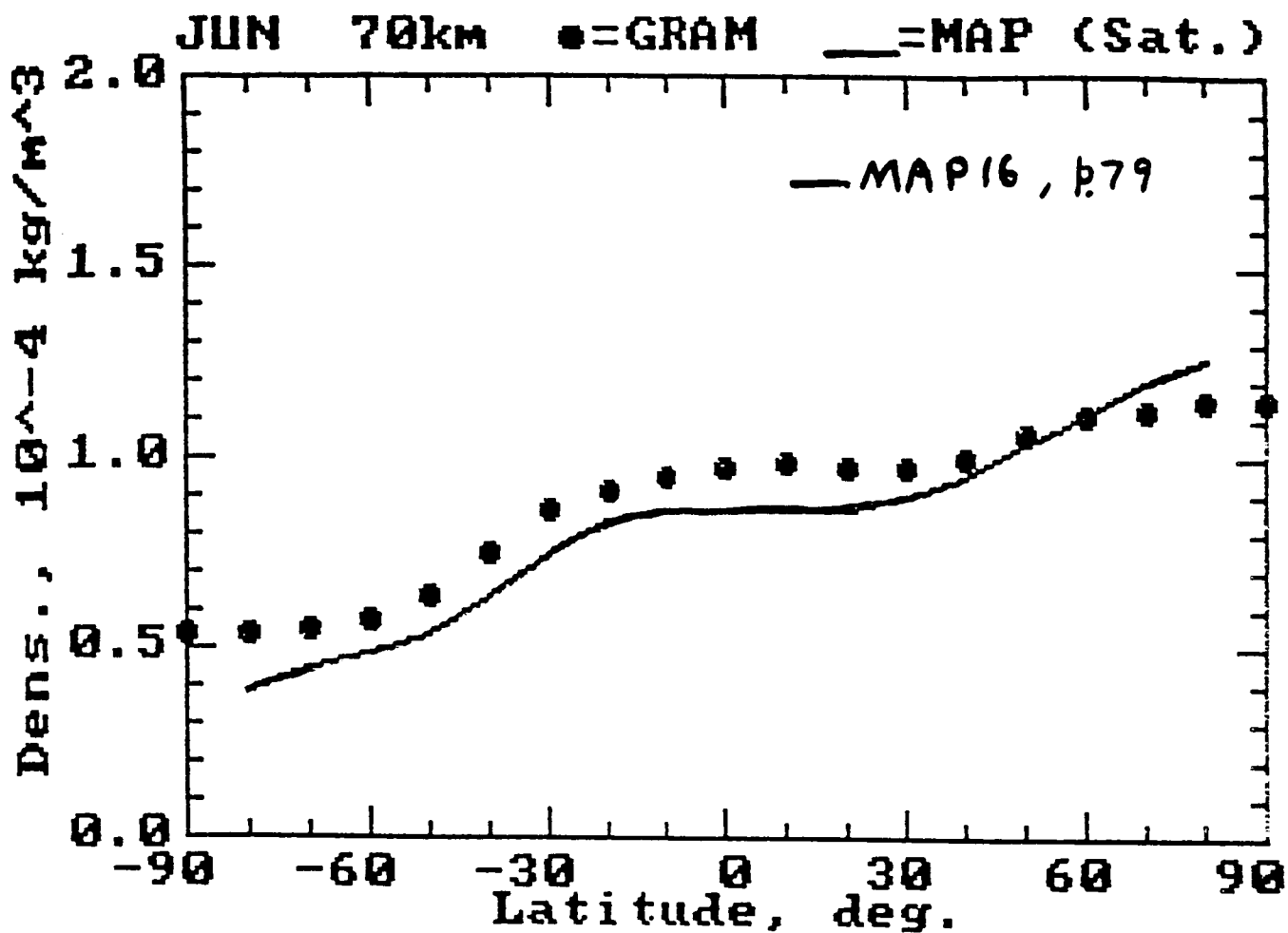


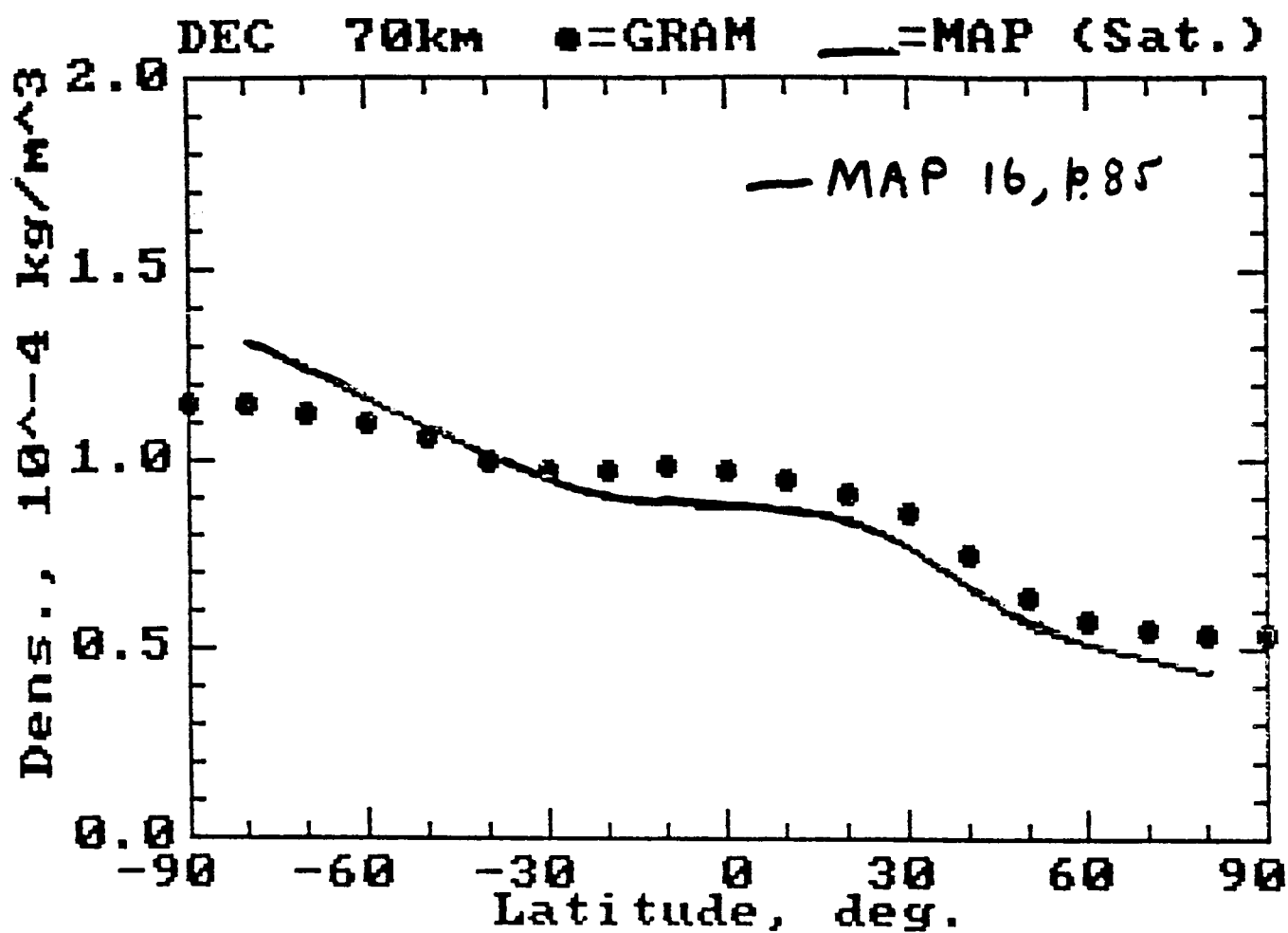


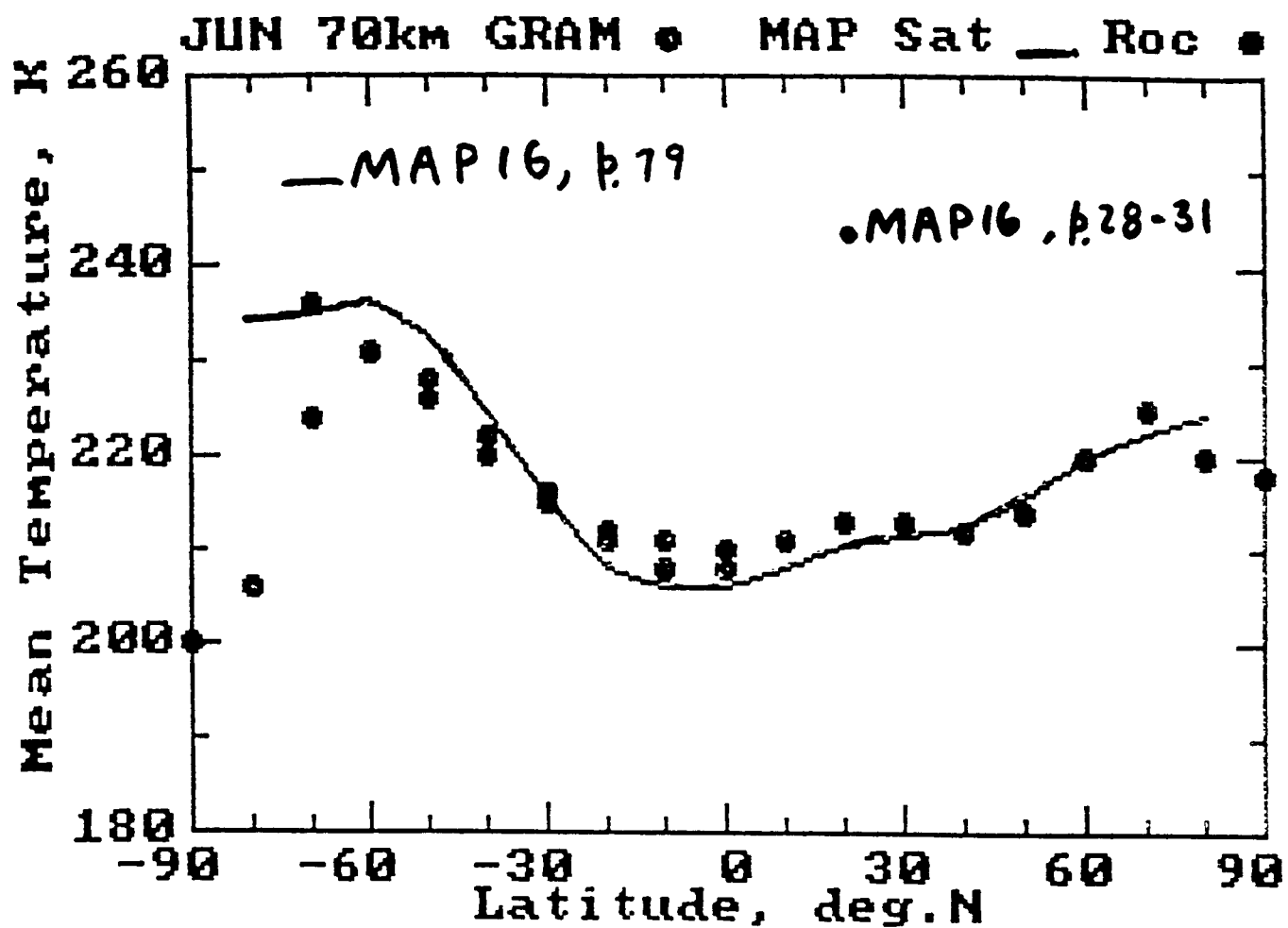
DECEMBER Lat=30 Z=70km

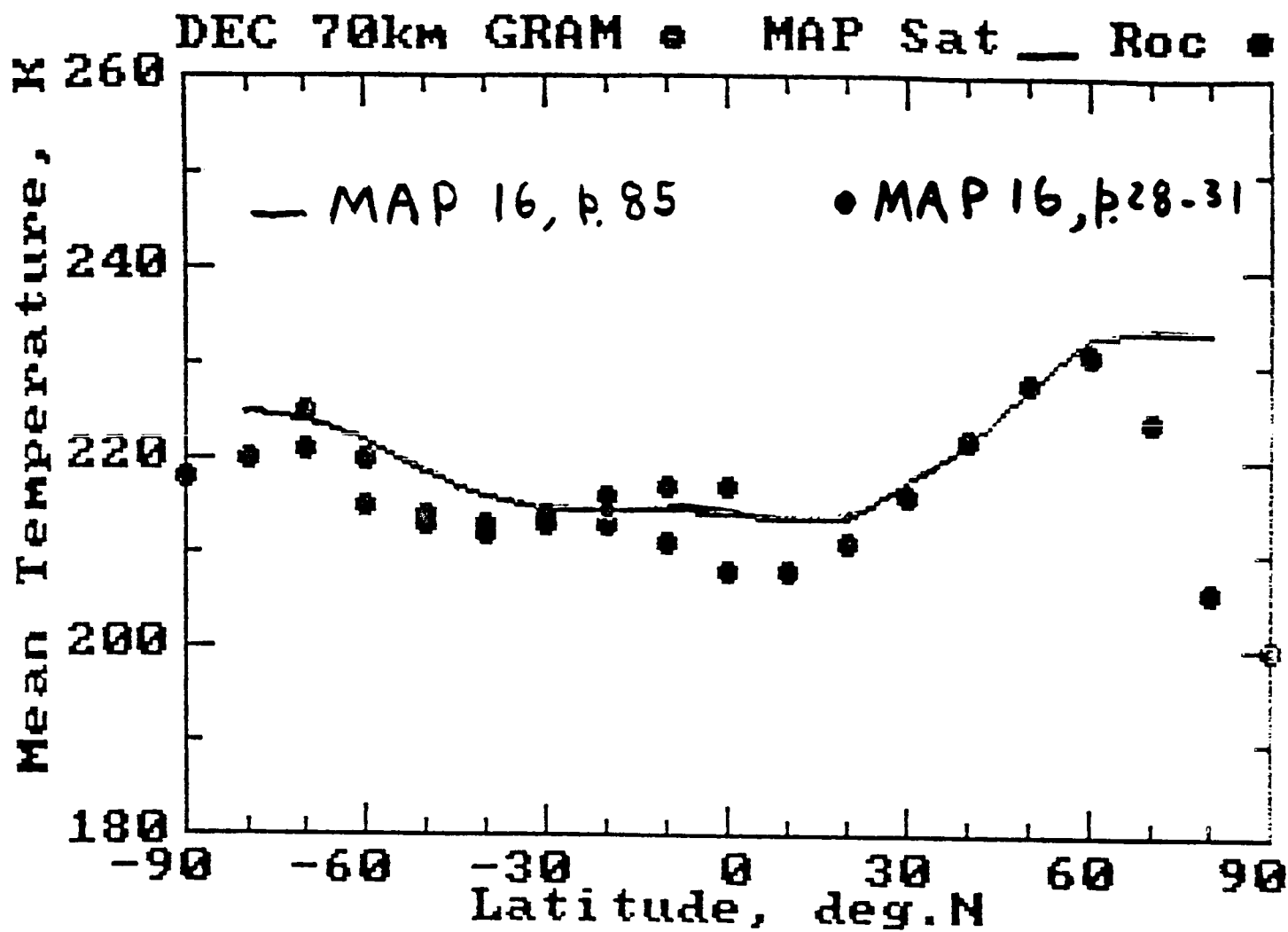












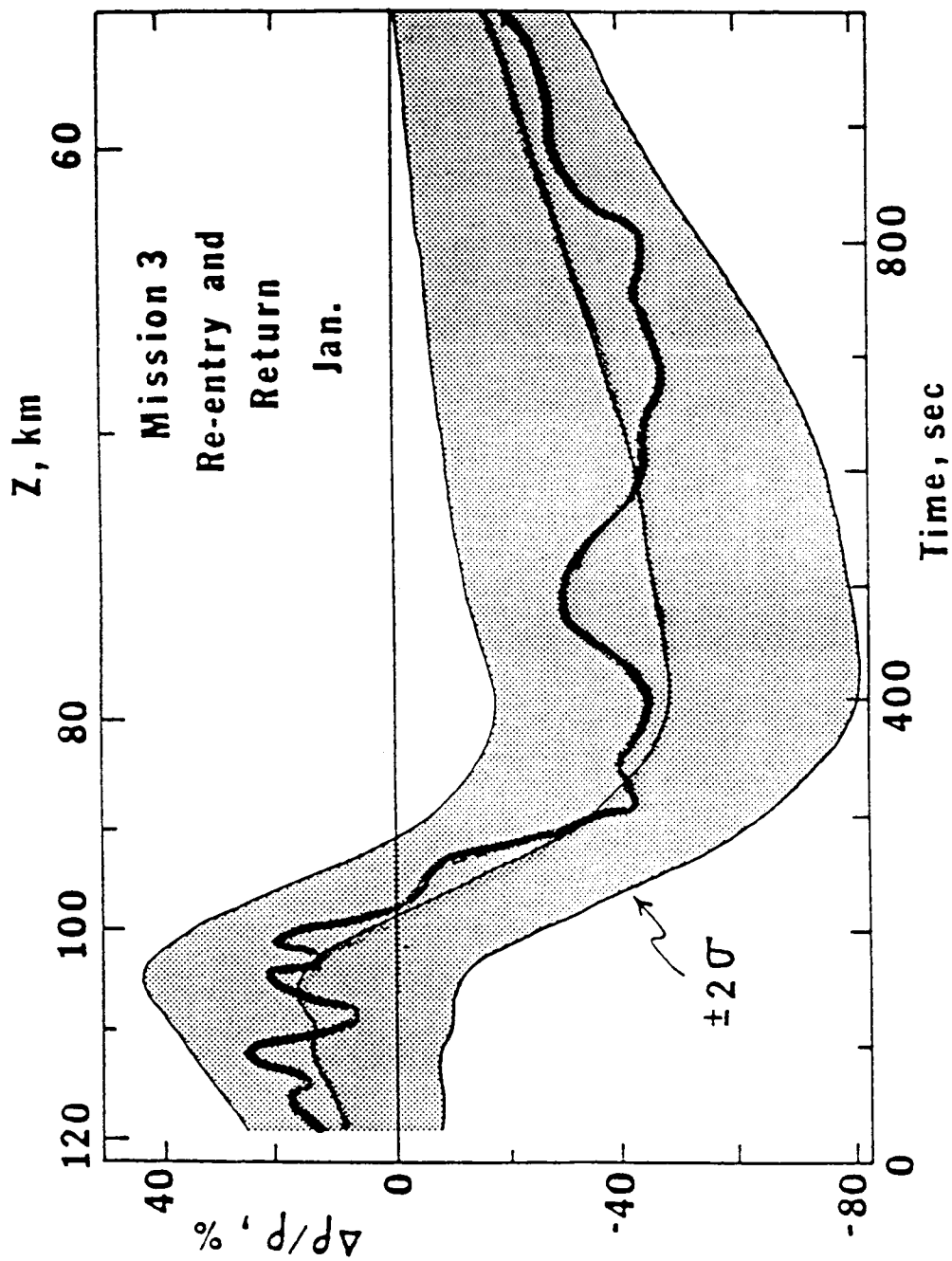


Figure 10.6 Density along a January mission 3 (Vandenberg polar orbit) re-entry and return trajectory. Density deviations are with respect to the 1962 U.S. Standard Atmosphere Graph symbolism as in Figure 10.2.

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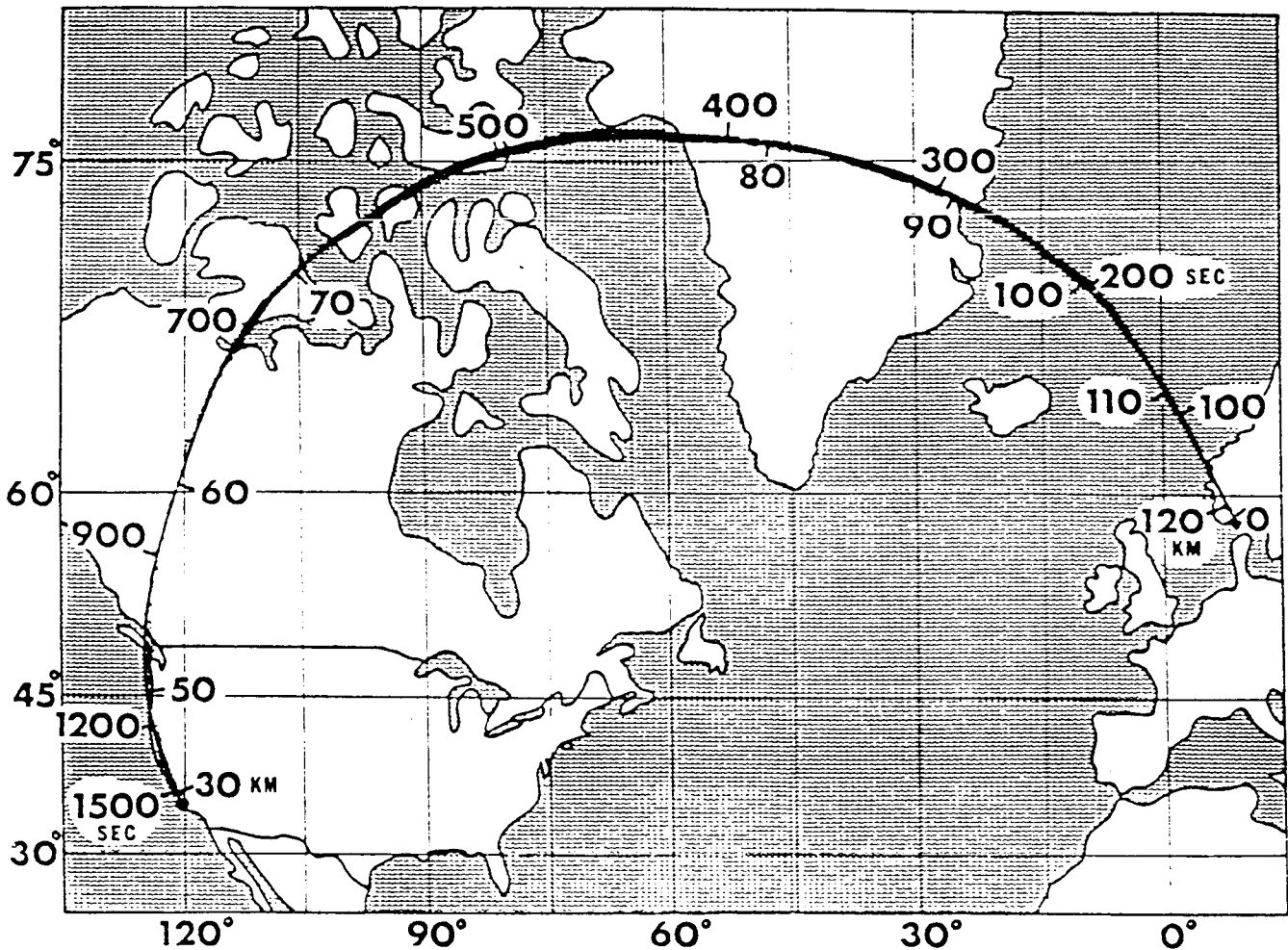


Figure 10.5 Ground plot of the re-entry and return trajectory for mission 3, a 104° inclination polar orbit launched from and returning to Vandenberg AFB. The altitude in km is plotted on the inner side of the orbital plot and the time in seconds is plotted on the outer side.